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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/917,381	07/27/2001	Jeffrey Joseph Stewart		9969

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EXAMINER	
CHENCINSKI, SIEGFRIED E	
ART UNIT	PAPER NUMBER
3628	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/917,381	STEWART, JEFFREY JOSEPH	
	Examiner	Art Unit	
	Siegfried E. Chencinski	3628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 July 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

1. **Claims 1-20 are rejected under 35 U.S.C. 101** because the claimed invention is directed to non-statutory subject matter. Claims 1-20 are not directed to any one of the areas of patentable subject matter, such as product, process, process of making or composition.

For a claim to be statutory under 35 USC 101 the following two conditions must be met:

1) In the claim, the practical application of an algorithm or idea results in a useful, concrete, tangible result,

AND

2)The claim provides a limitation in the technological arts that enables a useful, concrete, tangible result.

According to the above guidelines, Applicant's claims are limited to the manipulation of abstract ideas in the context of patentability.

Applicant is advised to satisfy the statutory requirements for the claims. Applicant is also advised not to add any new matter to the specification or the claims.

2. **Claims 1-20 are rejected under 35 U.S.C. 101** because the claimed invention is not supported by either a novel asserted utility or a well established utility.

Applicant asserts in the Summary of the Invention section of the specification that "an object of the present invention is to provide a novel financial security for the financing of pharmaceutical R&D" (Page 10, lines 22-24). However, Applicant fails to

claim limitations in independent claims 1, 10 and 11 which relate to the provision of financial securities. Instead, Applicant merely claims equations for valuing investment project expenditures based on estimated future streams of pharmaceutical project expenditures and the related detailed steps for defining and quantifying the variables making up the equations. Further, Applicant's disclosure fails to contain descriptive material relating to the provision of financial securities by only containing methods of financially valuing investment project expenditures based on estimated future streams of pharmaceutical project expenditures.

3. **Claims 11-20 are rejected under 35 U.S.C. 101** because the claimed recitation of a use, without setting forth any steps involved in the process, results in an improper definition of a process, i.e., results in a claim which is not a proper process claim under 35 U.S.C. 101. See for example *Ex parte Dunki*, 153 USPQ 678 (Bd.App. 1967) and *Clinical Products, Ltd.* v. *Brenner*, 255 F. Supp. 131, 149 USPQ 475 (D.D.C. 1966). Claim 11 claims a financial security by merely reciting a method of valuing a pharmaceutical R&D cash flow without setting forth any steps involved in the process of establishing and providing a financial security.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. **Claims 1-20 is also rejected under 35 U.S.C. 112, first paragraph.** Specifically, since the claimed invention is not supported by either a novel asserted utility or a well established utility for the reasons set forth above, one skilled in the art clearly would not know how to use the claimed invention. As stated in the rejection of Applicant's claimed invention under the provisions of 35 U.S.C. 101 Applicant's specification fails to contain descriptive material relating to the provision of financial

securities by only containing methods of financially valuing investment project expenditures based on estimated future streams of pharmaceutical project expenditures. Valuation methods and related algorithms for valuing prospective expenditures and cash flows are not statutory inventions, and also are not financial securities.

5. **Claims 1-9 are rejected under 35 U.S.C. 112, first paragraph,** as based on a disclosure which is not enabling. Clear guidelines and boundaries for the variable R, the project risk and project phase risk measure, critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). whether R sub 0 or R sub n, are absent from the disclosure, both in the specification and in the claims.

> The following is a quotation of the second paragraph of 35 U.S.C. 112:
>
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. **Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph,** as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

a) Applicant asserts in the Summary of the Invention section of the specification that "an object of the present invention is to provide a novel financial security for the financing of pharmaceutical R&D" (Page 10, lines 22-24). However, Applicant fails to claim limitations in independent claims 1, 10 and 11 which relate to the provision of financial securities. Instead, Applicant merely claims equations for valuing investment project expenditures based on estimated future streams of pharmaceutical project expenditures and the related detailed steps for defining and quantifying the variables making up the equations. Further, Applicant's disclosure fails to contain descriptive material relating to the provision of financial securities by only containing methods of financially valuing investment project expenditures based on estimated future streams of pharmaceutical project expenditures.

7. **Claims 1-9 are rejected under 35 U.S.C. 112, second paragraph,** as being incomplete for omitting essential elements, such omission amounting to a gap between the elements. See MPEP § 2172.01. The omitted elements are: the needed limits and guidelines for the variables R sub 0 and R sub y. The current definitions in the claim fail to enable ordinary practitioners of the art to replicate the calculations and obtain a consistent result for the same project if they were to do the calculations independently from each other. Further, the specification does not provide sufficient guidelines to even obtain Applicant's calculational results for at least Example 1 which the examiner attempted to calculate, without investing in burdensome experimentation.

8. **Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph,** as being incomplete for omitting essential elements, such omission amounting to a gap between the elements. See MPEP § 2172.01. The omitted elements are: a novel financial security for the financing of pharmaceutical R&D, as stated in the Summary of the Invention section of the specification (Page 10, lines 22-24).

9. **Claims 1-9 are rejected under 35 U.S.C. 112, first paragraph,** as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicant claims to have invented a novel financial security for the financing of pharmaceutical R&D, as stated in the Summary of the Invention section of the specification (Page 10, lines 22-24), and in claim 11. However, there is no evidence in the disclosure that Applicant had actually had possession of the claimed invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 1-5 10, 11, 18 & 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Martin, Petty, Keown and Scott, Basic Financial Management, 5th Ed., 1991, Prentice Hall (hereafter Martin) in view of Weiss (Introductory Statistics, Fifth Edition, Addison Wesley Longman, Inc., March 1999) and Horrigan et al. (US Patent 6,493,682 B1, hereafter Horrigan).

Re. Claim 1, Martin discloses a method of estimating the value of a proposed investment at various points in time, which includes the value at the time of the investment (time zero), as part of a textbook which teaches the building blocks of the mathematics of finance.

Applicant has restated the well known financial equations for present project valuation into one equation which can be used to calculate value at any milestone of a proposed project in certain time increments, such as yearly, beginning at time zero.

The equation contains the following elements:

- A summation feature of adding up each time period's value through the last project period (year n);
- Two sub component equations for each time increment for income and expenses (I & E); and
- Two discount factors for the value of cash for each time segment, (a) representing a basic cost of capital (k for discount rate) and, (b) a risk mitigation factor R to represent the differing estimated risk levels in each project phase (R sub 0 through n to match each risk phase).

Applicant's version of this valuation technique remains unchanged from the textbook concepts and equations in spite of different representations of the same equations. Martin builds up to the final risk mitigation by beginning with the risk free cost of capital, then introducing a firm's own general cost of capital, and finally adding the specific risk factor related to a given project.

Martin discloses a generic version of the discounted cash flow equation on page 109,

line 3 – page 110, line 21 (Summary of the General Valuation Process and equation 4-10, with notes). Here income and expenses are netted out through a combined variable C (cash flow).

It would have been obvious to those with ordinary skill in the art at the time of Applicant's invention that Applicant's claimed equation for estimating the value of expected future pharmaceutical R&D cash flow is merely a specific application of equations used in the financial arts and specifically taught by Martin in his textbook.

Next, Weiss discloses Applicant's conditional probability equation on page 240, line 2 of his textbook. Further, the use of conditional probability equations was well established in the financial arts at the time of Applicant's invention. For example, Horrigan discloses the use of conditional probability analysis in the investment art (Col. 22, l. 33). The fact that conditional probability art has various detailed equations would have been obvious to the ordinary practitioner, since he would have known that he only had to look them up in textbooks or perhaps even on the world wide web.

Therefore, it would have been obvious to the ordinary practitioner of the art at the time of Applicant's invention to have combined the basic teachings of Martin with the teachings of Weiss and Horrigan to adapt basic techniques of the financial art to the application of valuing financing proposals for pharmaceutical R&D projects using estimated (pro forma) cash flows through all the phases of the project from inception through the estimated completion of the project's revenue phase. The motivation would have been to bring to bear the resources and best practices of financial institutions to fund pharmaceutical R&D investments, modeled after the purposes and practices of finance presented by Martin's textbook where the objective of finance is presented to be to raise funds for investment by a non financial company from the financial markets through institutions and procedures (Martin, p. 25, l. 7-8).

Re. Claim 2, Martin uses different mathematical symbols which have the same meaning as those used by applicant's invention. As per the rejection of claim 1, Martin teaches and suggests the equivalent of time 0 is the present time and where $V_{(Vsub0)}$ is the risk-adjusted net present value of a pharmaceutical R&D cash flow.

Re. Claim 3, as per the rejection references in Martin's textbook in claim 1, Martin discloses,

suggests and implies that estimated future project income sources can be based on various sources, including project sales revenue.

Re. Claim 4, as per the rejection references in Martin's textbook in claim 1, Martin discloses, suggests and implies that estimated future project expense sources can be based on various sources, including the project's estimated manufacturing expenses.

Re. Claim 5, Martin discloses the risk-free interest rate in numerous places in the context of equations to value an investment project. This is the rate for US government bonds. One place is in chapter 7, page 277, line 12.

Re. Claim 10, Martin discloses a method of estimating the value of a debt with a coupon rate issued on an anticipated future cash flow, including the consideration of project risk see the rejections of claims 1 and 11). Weiss discloses a variety of probability calculation techniques and related equations (see the rejection of claim 1 and 11). Horrigan teaches the application of probability techniques in the financial investment arts (see the rejection of claims 1 and 11). Neither Martin, Weiss or Horrigan explicitly disclose Applicant's particulars of estimating the value, at time 0, of a debt issued on a pharmaceutical R&D cash flow, said method comprising calculating V_o in accordance with the equation: $V_o=R_oF\ (1+q-w)\}^y$, where R_o is the risk mitigated at time 0, F is the face value of said debt, q is interest rate of said debt, w is the risk-free interest rate, y is the time said debt is due to be repaid, and R_oF is the discount price. However, it is implicit in Martin that Martin's teachings apply to all kinds of financings and valuations thereof, including pharmaceutical R&D projects, and the ordinary practitioner of the art at the time of Applicant's invention would have seen that as obvious. Also, Applicant's equation contains the risk mitigation variable for the project as a whole, which is readily suggested by both Martin and Weiss. Further, the equation in this claim is related to the equation in claim 11, with the difference being the coupon. Therefore, it would have been obvious to the ordinary practitioner of the art at the time of Applicant's invention to have combined the basic teachings of Martin with the teachings of Weiss and Horrigan to adapt basic techniques of the financial art to the application of valuing financing proposals for pharmaceutical R&D projects using estimated (pro forma) cash flows through all the phases of the project from inception through the estimated completion of the project's

revenue phase. The motivation would have been to bring to bear the resources and best practices of financial institutions to fund pharmaceutical R&D investments, modeled after the purposes and practices of finance presented by Martin's textbook where the objective of finance is presented to be to raise funds for investment by a non financial company from the financial markets through institutions and procedures (Martin, p. 25, l. 7-8).

Re. Claim 11, Martin discloses a method of estimating the value of a debt security issued on an anticipated future cash flow, including the consideration of project risk (see the rejection of claim 1). Weiss discloses a variety of probability calculation techniques and related equations (see the rejection of claim 1). Horrigan teaches the application of probability techniques in the financial investment arts (see the rejection of claim 1). Martin does not explicitly disclose Applicant's version of a financial security comprising a debt issued at time 0 on a pharmaceutical R&D cash flow, said security comprising a face value, at least one default term, an interest rate, at least one repayment term, and a discount price, where said discount price D is calculated in accordance with the equation D=RoF, where Ro is the risk mitigated at time 0, and where F is said face value. The financial profile of Applicant's security fits that of a zero coupon bond.

The Martin textbook discloses the equivalent of Applicant's equation and many variations thereof by developing the subject from the ground up through building blocks, various overviews and many details of the practice of the financial art involving financial debt securities. Martin explains the features, benefits, advantages, disadvantages and interplays between these forms of financing for a firm and how the cost of capital, risk, time, revenue, expense, cash flow, investment, present value, net present value, future value and related factors are considered, estimated and calculated in the art of finance. The zero coupon bond is described on page 720. A zero coupon bond is a bond which pays no interest or dividends during the life of the bond and which is sold at a deep discount to its face value at the time of issuance. The bond holder of a zero coupon bond depends entirely on capital appreciation for his return on investment. Martin discloses an example of such a bond financing on page 720 by way of illustrating a $1,000 zero coupon bond issued in April, 1983 by Homestead Savings at a discount of

$ 750, meaning that the original bond buyer paid $ 250 for this $ 1000 par value bond which matured in 1995. Presuming that the bond was paid at the full face or par value of $ 1,000 at maturity, the original investor who held it for the entire 12 years earned a yield of 11.50 percent per year compounded for the twelve year period. The benefit to the issuer was that they received $ 250 of cash per $ 1000 par value bond, and had no cash outflows for the entire 12 year period by promising to pay back 12 years later 400% (four times) of the original cash received from investors.

Risk is basically the interest rate (or discount rate) which is added to the riskless cost of capital (defined as the equivalent cost of a US government note) to make up the total of the coupon rate and the discount rate. Totals risk is made up of a number of risk components. One way to summarize the risk elements is to categorize risk into two risk elements, the risk of the firm, and project risk. The general risk free cost of capital plus the firm's general risk premium join to form the firm's cost of capital, also known as the discount rate. Applicant's invention presents their discount price formula D in this well known format taught by Martin. Some additional considerations are taught by Martin regarding Applicant's project formulation as follows: Some long term debt only carries a coupon rate, some long term debt only carries a discount rate (zero coupon debt) and some debt carries a combination of the two. It can get more complicated than that, since conversion right, and other instruments can also be combined with the issuance of debt instruments. Martin discloses related equations with notations which differ from those used by Applicant, but these differences are merely superficial. The Martin textbook also discloses the central role played by cash flow in the finances of a company and in the related analysis of future financing risks by all the parties involved (p. 94, l. bottom – p. 96, middle).

Applicant's equation "$D = R_oF$" basically describes the calculation of the discounted price or value of the zero coupon bond described above. In the case of the Homestead Bank example of a zero coupon bond, Applicant's D has a $250 value at the time of issuance, R_o is an approximate annual yield of 11.75% and $ 1000 is the face value of the bond. An example of the equation is presented by Martin on page 143, as $V_b = (I_1/(1+R_b)^1 + \ldots + I_{12}/R_N) + M/(1+R)^N$, where interest payments (I) are zero, M is $ 1,000,

and R_b is approximately 0.1175 (11.75%). With interest payments equaling zero, the equation reduces to $V_b = 0 + M/(1+R)^N$. It is implicit to Martin's disclosure that the financial methodology disclosed in his textbook can be applied to any industry. Therefore, an ordinary practitioner of the art at the time of Applicant's invention would have found it obvious to have used Martin's disclosure to construct a financial security issued on a pharmaceutical R&D cash flow. The motivation would have been to bring to bear the resources and best practices of financial institutions to fund pharmaceutical R&D investments, modeled after the purposes and practices of finance presented by Martin's textbook where the objective of finance is presented to be to raise funds for investment by a nonfinancial company from the financial markets through institutions and procedures (Martin, p. 25, l. 7-8).

Re. Claim 18, Martin discloses convertible debt and that the debt of a firm can be convertible debt (pp. 743-744).

Re. Claim 20 Martin teaches and suggests that the ability to repay debt at the repayment term is estimated from projected net cash flow of the revenue phase (see claims 1 and 11, above).

11. Claims 6-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Martin in view of Weiss and Horrigan as applied to claim 1 above, and further in view of Applicant Admitted Prior Art (hereafter AAPA).

Re. Claims 6-9, Martin does not explicitly disclose

- **Re. Claim 6,** where at least one expense, risk, or the time of a pharmaceutical R&D phase is estimated to be about average.
- **Re. Claim 7,** average expenses for selected pharmaceutical R& D project phases, including a phase 1 clinical trial expense of about $575,000, a phase 2 clinical trial expense of about $2,300,000, a phase 3 clinical trial expense of about $17,250,000, an animal study expense in support of a phase 1 clinical trial of about $500,000, an animal study expense in support of a phase 2 clinical trial of about $1,000,000, an animal study expense in support of a phase 3 clinical trial of about $1,500,000, and an approval-associated expense of about $1,300,000.

- **Re. Claim 8,** where said average risk Ry is selected from the group consisting of about 10% for a preclinical phase, about 20% for a phase 1 clinical trial phase, about 30% for a phase 2 clinical trial phase, about 67% for a phase 3 clinical trial phase, and about 83% for an approval phase.
- **Re. Claim 9,** where said average time of a pharmaceutical R&D phase is selected from the group consisting of about 6 years for a preclinical phase, about 9 months for a phase 1 clinical trial, about 1.5 years for a phase 2 clinical trial, about 3.5 years for a phase 3 clinical trial, about 1.5 years for an approval phase, and about 10 years for a revenue phase.

However, AARA discloses each of these expenses in the specification's Background section as admitted prior art knowledge on page 1, line 10 – page 5, line 11. Therefore, it would have been obvious to an ordinary practitioner of the art at the time of Applicant's invention to have turned to a finance textbook such as that of Martin to adapt a standard equations for estimating the value at time zero of streams of present and future expenditures and incomes in various renditions and combinations to pharmaceutical R&D risk mitigation scenarios with AAPA information for the values of the expense and income variables. The motivation would have been to bring to bear the resources and best practices of financial institutions to fund pharmaceutical R&D investments, modeled after the purposes and practices of finance presented by Martin's textbook where the objective of finance is presented to be to raise funds for investment by a nonfinancial company from the financial markets through institutions and procedures (Martin, p. 25, l. 7-8).

12. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Martin in view of Weiss and Horrigan as applied to claim 11 above, and further in view of Kossovsky et al. (US Pg. Pub. 2002/0002523 A1, hereafter Kossovsky).

Re. Claim 12, Martin does not explicitly disclose a security where debt is securitized by intellectual property that, but for license to said intellectual property, the making, using, or selling of said pharmaceutical would infringe upon at least one valid claim of said intellectual property. However, Martin discloses secured debt instruments ("Secured

Long-Term Bonds" (pp. 716)). Kossovsky discloses intellectual property and securitized asset cash flow (page 1, [0009], ll. 1-7). Further, an ordinary practitioner of the art at the time of Applicant's invention would have known that the making, using, or selling of a pharmaceutical which is dependent on a given intellectual property (such as a patent) would infringe upon at least one valid claim of such intellectual property by definition, and that such infringement would need to be permitted by the intellectual property owner's own infringement (actually called use of the rights held by the property), which would be legal, or by the owner's giving permission for someone else to infringe on the intellectual property's rights. Therefore, an ordinary practitioner of the art at the time of Applicant's invention would have found it as obvious to have combined the teachings of Martin, Kossovsky and well known information to have provided a debt securitized by intellectual property related to a pharmaceutical, motivated by a desire to support the efficient and reliable commercial exploitation, licensing or assigning of intellectual property rights (Kossovsky, page 1, [0007]-ll. 1-4; [0008]).

13. **Claims 13-17 are rejected** under 35 U.S.C. 103(a) as being unpatentable over Martin in view of Weiss and Horrigan as applied to claim 11 above, and further in view of AAPA.

Re. Claims 13-17, Martin does not explicitly disclose

Re. Claim 13, said pharmaceutical is at a preclinical phase of development and where said Ro is about 10%.

Re. Claim 14, where said pharmaceutical is at a phase 1 clinical trial phase of development and where said Ro is about 20%.

Re. Claim 15, where said pharmaceutical is at a phase 2 clinical trial phase of development and where said Ro is about 30%.

Re. Claim 16, where said pharmaceutical is at a phase 3 clinical trial phase of development and where said Ro is about 67%.

Re. Claim 17, where said pharmaceutical is at an approval phase of development and where said Ro is about 83%.

However, APPA admits that

Re. Claim 13, Ro is about 10% for pharmaceuticals at a preclinical phase of development.

Re. Claim 14, Ro is about 20% for pharmaceuticals at a phase 1 clinical trial phase of development.

Re. Claim 15, Ro is about 30% for pharmaceuticals at a phase 2 clinical trial phase of development.

Re. Claim 16, Ro is about 67% for pharmaceuticals at a phase 3 clinical trial phase of development.

Re. Claim 17, Ro is about 83% for pharmaceuticals at an approval phase of development.

However, AAPA discloses these limitations in the background section of the specification (p. 1, l. 10 – p. 4, l. 18).

Therefore, an ordinary practitioner of the art at the time of Applicant's invention would have found it as obvious to have combined the teachings of Martin and AAPA to have provided a debt securitized by intellectual property related to a pharmaceutical various phases claimed in the limitations of claims 13-17 (Specification, p. 1, l. 10 – p. 5, l. 11). The motivation would have been to bring to bear the resources and best practices of financial institutions to fund pharmaceutical R&D investments, modeled after the purposes and practices of finance presented by Martin's textbook where the objective of finance is presented to be to raise funds for investment by a nonfinancial company from the financial markets through institutions and procedures (Martin, p. 25, l. 7-8).

14. **Claim 19 is rejected** under 35 U.S.C. 103(a) as being unpatentable over Martin in view of Weiss and Horrigan as applied to claim 11 above, and further in view of Barron's Dictionary of Finance and Investment (hereafter Barron's).

Re. Claim 19, Martin discloses the possibility of default on a bond (p. 723, l. 18-19). The possibility and likelihood of such a default is what is implicit to what the risk is, risk being reflected in the discount premium above the risk free premium (the rate of US government debt). Barron's defines default as "failure of a debtor to make timely payments of interest and principle as they come due or meet some other provision of a

bond indenture. In the event of default, bondholders may make claims against the assets of the issuer in order to recoup their principle". (p. 140, default). Thus, Martin and Barron's disclose default on a bond debt, with Barron's defining default as a failure to pay a scheduled debt repayment. Therefore, an ordinary practitioner of the art at the time of Applicant's invention would have found it as obvious to have combined the teachings of Martin and Barron's have provided a debt securitized by intellectual property related to a pharmaceutical various phases claimed in the limitations of claims 13-17. The motivation would have been to bring to bear the resources and best practices of financial institutions to fund pharmaceutical R&D investments, modeled after the purposes and practices of finance presented by Martin's textbook where the objective of finance is presented to be to raise funds for investment by a nonfinancial company from the financial markets through institutions and procedures (Martin, p. 25, l. 7-8).

15. INTERPRETATION OF CLAIMS: The recitation of a method of estimating value of a pharmaceutical R&D cash flow in claims 1, and10 and a financial security comprising a debt issued at time 0 on a pharmaceutical R&D cash flow in claim 11 have not been given patentable weight because the recitations occur in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

Conclusion

16. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Siegfried Chencinski whose telephone number is

(571)272-6792. The Examiner can normally be reached Monday through Friday, 9am to 6pm.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Hyung S. Sough, can be reached on (571) 272-6799.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Any response to this action should be mailed to:

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2002/0002523	01-2002	Kossovsky et al.	705/36
*	B	US-6,493,682	12-2002	Horrigan et al.	705/36R
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NON-PATENT DOCUMENTS

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	U	Martin, Petty, Keown and Scott; Basic Financial Management; 1991; Prentice Hall, Inc.;5th Ed.; pp. vii-ix, 25, 94-96, 109, 110, 143, 713, 720, 723, 743, 744.
	V	John Downes and Jordan Elliot Goodman; Dictionary of Finance and Investment Terms; Barron's Educational Series, Inc.; 19898; pp. 140, 141, 464, 465, 524, 525.
	W	Neil A. Weiss, Introductory Statistics, March1999, Addison Wesley Longman, Inc., pp. 235-239.
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BASIC FINANCIAL MANAGEMENT

Martin
Petty
Keown
Scott

FIFTH EDITION

5th Edition

BASIC FINANCIAL MANAGEMENT

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CONTENTS IN BRIEF

PART 7

SPECIAL TOPICS IN FINANCIAL MANAGEMENT

The Financial Markets: An Introduction

The study of financial markets is a vast undertaking; however, for the time being, our interest is restricted to the rates of return earned by the investor in these markets. Specifically, we are interested in the profit opportunities available to the investor in the financial markets, an issue of great relevance for the financial manager.

The financial markets represent the institutions and procedures used by nonfinancial companies in raising funds for investments. The financial markets bring together the net savers with the net users of funds. For example, a personal investor is a net saver, saving more than he or she spends from his or her income. On a larger scale, an insurance firm is a net saver, needing to invest cash received from insurance premiums. A firm, on the other hand, is oftentimes a net user, investing more than the firm's income. Thus, as a net user of funds, the firm must raise funds in the financial markets, either in the form of debt or equity. Also, since there will be other entities needing funds, including both businesses and governments, the firm must offer the investor a return that is attractive, given the investor's next best opportunity. Thus, the cost of money to the firm will invariably be the investor's next best opportunity for the given level of risk being assumed. For example, suppose Arko, Inc., wants to issue bonds (debt) to finance a plant expansion. If the investor can earn an 11 percent return on another bond that is similar in risk and maturity to Arko's bonds, Arko will have to offer at least an 11 percent return on its bonds; that is, the firm must meet the investor's opportunity cost. Otherwise, the investor will not be interested in purchasing Arko's bonds.

The **opportunity cost** concept is one that is extremely important in finance, especially as we make investment and financing decisions. Never should we base our decisions on past or historical costs, even when they represent the actual out-of-pocket costs to the firm. The temptation to use historical costs is sometimes more than we can stand; however, we must abstain if we are to work in the best interest of the common stockholder. Maximizing shareholder wealth means that we make decisions based upon our understanding of the investor's best alternative opportunities. In the case of investment and financing decisions, the opportunity cost for the firm's investors is captured in the rates of return available in the financial markets.

Perspective in Finance

No single concept is more important in finance than that of the "opportunity cost." It matters not that your firm's debt has a cost of 12 percent; the more important issue in making financial decisions is what would it cost the firm to issue the debt today. Put another way, would you loan a firm money at 13 percent if you could earn 15 percent on a "similar" investment? Not if you have any "smarts"!!!

Observed Rates of Return in the Financial Markets

History can tell us a great deal about the returns that investors earn in the financial markets. A primary source for a historical perspective comes from Ibbotson and Sinquefield's *Stocks, Bonds, Bills, and Inflation*, which examines the realized rates of return for a wide variety of securities spanning the period

drive the market price back into equilibrium with intrinsic value. Thus, we may define an **efficient market** as one in which the values of all securities at any instant in time fully reflect all available information, which results in the market value and the intrinsic value being the same. If the markets are truly efficient, it is extremely difficult for an investor to make extra profits from an ability to predict prices.

The idea of market efficiency has been the backdrop for an intense battle between professional investors and university professors. The academic community has contended that a blindfolded monkey throwing darts at the list of securities in the *Wall Street Journal* could do as well as a professional money manager. Market professionals, on the other hand, retort that academicians are so immersed in research they could not recognize potential profits even if they were delivered to their offices. The war has been intense, but one that the student of finance should find intriguing.

Perspective in Finance

Value is the present value of expected future cash flows. This fact is true regardless of what type of asset we are valuing. If you remember only one thing from this chapter, remember that value is the present value of expected future cash flows.

The Basics of Valuation

For our purposes, we will refer to the value of an asset as its intrinsic value, which is the present value of its expected future cash flows, where these cash flows are discounted back to the present using the investor's required rate of return. Value is affected by three elements:

1. The amount and timing of the asset's expected cash flows
2. The riskiness of these cash flows
3. The investor's required rate of return for undertaking the investment

The first two factors are characteristics of the asset, while the required rate of return is the minimum rate necessary to attract an investor to purchase or hold a security. This rate must be high enough to compensate the investor for the risk perceived in the asset's future cash flows. These factors are depicted in Figure 4–1. As the figure shows, finding the value of an asset involves (1) assessing the asset's characteristics, which include the amount and timing of the expected cash flows and the riskiness of these cash flows; (2) determining the investor's required rate of return, which embodies the investor's attitude about assuming risk and perception of the riskiness of the asset; and (3) discounting the expected cash flows back to the present, using the investor's required rate of return. We will look at each of these considerations.

Perspective in Finance

Intrinsic value is a function of the cash flows yet to be received, the riskiness of these cash flows, and the investor's required rate of return.

Expected Cash Flows

The *expected* benefits received from an investment take the form of the cash flows it will generate. Therefore, cash flows (not accounting profits) are the relevant variable to be analyzed in measuring returns. This principle holds true

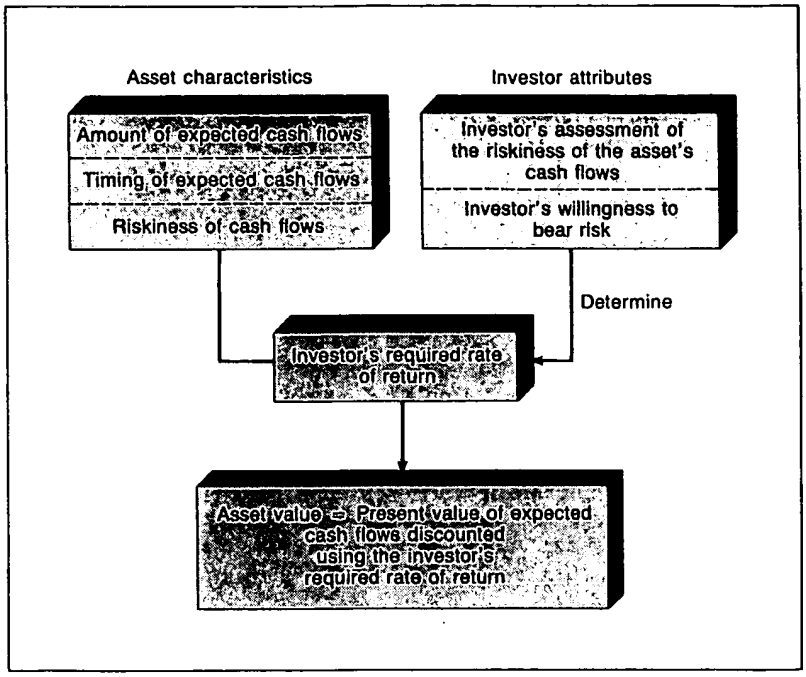


FIGURE 4–1.
Basic Factors Determining an Asset's Value

regardless of the type of security being valued: Whether we are analyzing a debt instrument, preferred stock, common stock, or any mixture of these securities (e.g., convertible bonds), the amount of expected future cash flows must be estimated in order to evaluate the benefits resulting from owning the investment.

Determining the amount of expected cash flows is almost never easy. In a world where the future is uncertain, the exact amount of cash flows to be produced from a security investment is seldom known. To illustrate: Assume you are considering an investment costing $10,000, where the future cash flows from owning the security depend upon the state of the economy and have been estimated as follows:

State of the Economy	*Probability of the States*[a]	*Cash Flows from the Investment*	*Percentage Returns (Cash Flow ÷ Investment Cost)*
Economic recession	20%	$1000	10% ($1000 ÷ $10,000)
Moderate economic growth	30%	1200	12% ($1200 ÷ $10,000)
Strong economic growth	50%	1400	14% ($1400 ÷ $10,000)

[a]The probabilities assigned to the three possible economic conditions have to be determined subjectively, which requires management to have a thorough understanding of both the investment cash flows and the general economy.

Thus, in any given year, the investment could produce any one of three possible cash flows depending upon the particular state of the economy. With this information, how should we select the most meaningful cash flow estimate for computing the security's value? One approach is to calculate an *expected* cash flow. The expected cash flow is simply the weighted average of the *possible* cash flow outcomes where the weights are the probabilities of the occurrence of

the various states of the economy. Let X_i designate the ith possible cash flow; N reflects the number of possible states of the economy, and $P(X_i)$ indicates the probability that the ith cash flow or state of economy will occur. The expected cash flow, $\overline{X}$, may then be calculated as follows:

$$\overline{X} = X_1P(X_1) + X_2P(X_2) + \cdots + X_NP(X_N)$$

or

$$\overline{X} = \sum_{i=1}^{N} X_iP(X_i) \qquad (4\text{–}1)$$

For the present illustration

$$\overline{X} = (.5)(\$1400) + (.3)(\$1200) + (.2)(\$1000) = \$1260$$

In addition to computing an expected dollar return from an investment, we can also calculate an expected percentage rate of return earned on the $10,000 investment on the security. The $1,400 cash inflow, assuming strong economic growth, represents a 14 percent return ($1400 ÷ $10,000). Similarly, the $1,200 and $1,000 cash flows result in 12 percent and 10 percent returns, respectively. Using these percentage returns in place of the dollar amounts, the expected rate of return, $\overline{R}$, is

$$\overline{R} = (.5)(14\%) + (.3)(12\%) + (.2)(10\%) = 12.6\%$$

With our concept and measurement of expected returns, let's consider the other side of the investment coin: risk.

Risk and Valuation

To gain a basic understanding of investment risk, there are at least three fundamental questions that we must ask:

1. What is risk?
2. How do we know the amount of risk associated with a given investment: That is, how do we measure risk?
3. If we choose to diversify our investments by owning more than one asset, as most of us do, will such diversification impact the riskiness of our combined portfolio of investments?[2]

What Is Risk?

Perspective in Finance

Risk is the potential variability in future cash flows. The wider the possible events that can occur, the greater the risk. Does that seem intuitive?

To help us grasp the fundamental meaning of risk, consider two prospective investments:

1. The first investment is a U.S. Treasury bill, a government security, that matures in 90 days and promises to pay an annualized return of 8 percent.

[2]The logic in this section is the same as that used in Chapter 6 for capital budgeting under uncertainty.

investor to purchase or hold a security. In the discussions that follow, this link will be demonstrated clearly as we value different types of securities.

Summary of the General Valuation Process

The valuation process involves calculating the present value of an asset's expected future cash flows using the investor's required rate of return. The investor's required rate of return, R, is determined by the level of the risk-free rate of interest, R_f, and the risk premium, RP, that the investor feels is necessary

be the primary goal of a Japanese investor. It seems perfectly clear that esteem can be just as important a valuation characteristic as income. Therefore, how can we subject the Japanese to what a friend of mine refers to as "the tyranny of the price/earnings ratio," when they do not subscribe to that notion at all?

In the global market, Latin America may be the most attractive region now. It offers some potentially exciting opportunities. Emerging market funds are gaining popularity, and Latin America seems to be emerging from its dark ages. One particularly appealing attribute is the region's lack of covariance with most of the other markets. The model of this region is close government and private control.

Again, as we begin to move toward a global market we will rely more and more on communications and technology. We conducted two experiments along these lines recently. Computerized global trading has some interesting implications for the price per square foot on stock exchanges. To demonstrate that point, we set up the Batterymarch computerized trading system on top of a mountain in Switzerland, and another in Rio de Janeiro. In both cases we were dealing with live activity, using our computer in Boston which trades directly on the London and Paris markets.

The market will become integrated because of these communication capabilities. The databases are becoming increasingly linked; eventually they will be consolidated into one or two strong databases. Deregulation, which is now a worldwide phenomenon, will accelerate this process. Competitive markets, in turn, will increase the likelihood of this trend toward deregulation. Cross-trading facilitates integrated markets. For example, today, Sony stock is traded in 18 markets. Equity prices will thrive in this climate, and be put to their best use.

The global market in this climate becomes countryless. Control is likely to be a major element, and currency will be dealt with as a separate characteristic. An elite set of global multinational companies is emerging today. These are companies with sales, production and ownership distributed across several countries. Already over 100 US companies are listed on at least one non-US stock exchange, and there are nearly 300 non-US companies listed in at least one country outside their home. In addition, the pace of acquisitions is picking up, with foreigners acquiring US operations worth $58 billion in 1987, up from $15 billion in 1981.

As corporations are increasingly valued in a global context, a significant problem continues to be the dramatic differences in accounting practices among countries. One analyst (Paul Aron of Daiwa Securities) has suggested that Japanese company earnings are undervalued by at least 50% relative to US generally accepted accounting principles. Many companies are taking the initiative here, ahead of their accountants, by issuing annual reports in other countries, reconciled to their standards.

Companies which move quickly to achieve global stature, regardless of their size, will achieve the highest valuations at the hands of the broadest spectrum of possible investors.

These global investors are in our midst now, and have been for several years. They know, for example, that Americans will understand gold as a normal repository of value, and that the Japanese will learn to buy stocks on the dividend discount basis as this cross-cultural exchange takes place. The ultimate asset sheet in this global market will list all assets—common data for all—and have the flexibility to specify the currency mix of choice of the investor. The successful investor in this transitional phase is one who moves to the integrated standard first. Those who do not will give up profit because of their high-confidence, local-market biases. The profitable issuers will be listed in many markets; they will push for disclosure; they will consolidate control; they will use complex derivative instruments when profitable to issue; and most important, they will see the world as the smallest unit of financial market segmentation.

Source: Dean LeBaron, "The Era of Global Corporate Valuation Has Arrived," *The Chief Financial Officer* (1988), 100–101.

to compensate for the risks assumed in owning the asset. Therefore, the basic security valuation model can be defined mathematically as follows:

$$V = \frac{C_1}{(1 + R)^1} + \frac{C_2}{(1 + R)^2} + \cdots + \frac{C_N}{(1 + R)^N}$$

or

$$V = \sum_{t=1}^{N} \frac{C_t}{(1 + R)_t} \qquad \textbf{(4–10)}$$

where V = the intrinsic value or present value of an asset producing expected future cash flows, C_t, in years 1 through N

R = the investor's required rate of return

Using equation (4–10), there are three basic steps in the valuation process:

Step 1: Estimate the C_t in equation (4–10), which is the amount and timing of the future cash flows the security is expected to provide.

Step 2: Determine R, the investor's required rate of return, using equation (4–6), that is, $(R = R_f + RP)$. We do this by evaluating the riskiness of the security's future cash flows and determining an appropriate risk premium, RP. We then observe the risk-free rate (such as the rate of interest on 90-day Treasury bills) and add the two together for the required rate of return.

Step 3: Calculate the intrinsic value, V, as the present value of expected future cash flows discounted at the investor's required rate of return.

With these general principles of valuation as a foundation, we can investigate the procedures for valuing particular types of securities. Specifically, we will learn how to value a bond, preferred stock, and common stock.

Bond Valuation

The process for valuing a bond requires first that we understand the terminology and institutional characteristics of a bond. More extensive coverage of the contractual provisions of a bond is provided in Chapter 19.

Perspective in Finance

The value of a bond is the present value of future interest to be received and the par or maturity value of the bond. Simply list these cash flows, use your discount rate of return, and find the value.

Terminology

When a company, or even a nonprofit institution, has a need for money, one source of financing is **bonds.** This type of financing instrument is simply a long-term promissory note issued by the borrower, promising to pay its holder a predetermined and fixed amount of interest each year. As a form of debt, a contract between the borrower and lender is executed, frequently called an **indenture.** Although the terms of the contract generally are extensive, incorporating detailed protective provisions for the creditor, only three items *directly*

APPENDIX 4A

More on Bond Valuation: Understanding Key Relationships

In the text of Chapter 4 we have learned to find the value of a bond (V_b), given (1) the amount of interest payments (I_t), (2) the maturity value (M), (3) the length of time to maturity (N years), and (4) the investor's required rate of return, R_b. We have also learned how to compute the expected rate of return, which also happens to be the current interest rate on the bond, given (1) the current market value (V_b), (2) the amount of interest payments (I_t), (3) the maturity value (M), and (4) the length of time to maturity (N years). These computations represent the basics of bond valuation; however, a more complete understanding of bond valuation requires that we examine five additional key relationships:

First Relationship

The value of a bond is inversely related to changes in the investor's present required rate of return (the current interest rate). That is, as interest rates increase (decrease), the value of the bond decreases (increases).

To illustrate, assume that an investor's required rate of return for a given bond is 12 percent. The bond has a par value of $1,000 and annual interest payments of $120, indicating a 12 percent coupon interest rate ($120 ÷ $1000 = 12%). Assuming a five-year maturity date, the bond would be worth $1,000, computed as follows:

$$V_b = \frac{I_1}{(1 + R_b)^1} + \cdots + \frac{I_N}{(1 + R_b)^N} + \frac{M}{(1 + R)^N}$$

$$= \sum_{t=1}^{N} \frac{I_t}{(1 + R_b)^t} + \frac{M}{(1 + R_b)^N} \qquad \textbf{(4–11a)}$$

$$= \sum_{t=1}^{5} \frac{\$120}{(1 + .12)^t} + \frac{\$1000}{(1 + .12)^5}$$

$$V_b = \$120 \begin{pmatrix} \text{table value,} \\ \text{Appendix D,} \\ \text{5 years,} \\ \text{12 percent} \end{pmatrix} + \$1000 \begin{pmatrix} \text{table value,} \\ \text{Appendix B,} \\ \text{5 years,} \\ \text{12 percent} \end{pmatrix} \qquad \textbf{(4–11b)}$$

$$V_b = \$120(3.605) + \$1000(.567)$$

$$= \$432.60 + \$567.00$$

$$= \$999.60 \cong \$1000.00$$

If, however, the investor's required rate of return (going interest rate) increases from 12 to 15 percent, the value of the bond would decrease to $899.24:

on borrowed funds. Bennett Stewart of Stern Stewart Management Services provides some perspective on just how bond ratings are actually determined in the *Readings in Financial Management*, "Bennett Stewart on Bond Ratings."

Determinants of the Cost of Long-Term Debt

In Chapter 12 we computed an investor's required rate of return for debt financing to the firm. We now focus on the factors that determine the required rate of return that investors demand on this debt. The total cost of debt that the firm will pay depends primarily upon five factors: (1) the size of the issue, (2) the issue's maturity, (3) the issue's riskiness or rating, (4) the restrictive requirements of the issue, and (5) the current riskless interest rate. To a large extent the administrative costs of issuing debt are fixed, and they will decrease in percentage terms as the size of the issue increases. In effect, economies of scale are associated with the issuance of debt. The issue's maturity also affects the cost of debt. Borrowers prefer to borrow for long periods in order to lock in interest rates and avoid the problem of frequent refinancing, while lenders would rather not tie up their money for long periods. In order to bring about equilibrium between supply and demand for funds, long-term debt generally carries a higher interest rate than short-term debt. This tends to encourage some borrowers to borrow for shorter periods and some investors to lend for longer periods, bringing equilibrium between supply and demand.

Investors also desire additional return for taking on added risk. Thus, the less risky the bond or the higher the bond rating, the lower will be the interest rate. We can see this by looking at the movement of bond yields for four different ratings during 1988, as shown in Table 19–2.

The restrictive requirements and rights of both issuer and holder also affect the interest rate paid on the bond. The more the bondholder requires in the way of protection and rights, the lower will be the rate of return earned. On the other hand, the more rights the issuer demands—for example, the right to repurchase the debt at a predetermined price (called a *call provision* and discussed later in detail)—the higher will be the rate that the issuer will have to offer in order to convince investors to purchase the bond.

Finally, the current riskless interest rate plays a major role in determining the cost of debt. As the riskless rate of interest moves up and down, parallel movements are produced for corporate bond rates. The determination of the riskless interest rate is generally deferred to courses on money and banking and

TABLE 19–2.
Comparison of Corporate Bond Yields of Various Ratings, Monthly Averages, 1988

	Ratings			
	Least Risk AAA	AA	A	Most Risk BBB
January	9.49%	9.89%	10.54%	11.03%
February	9.09	9.44	9.96	10.59
March	9.29	9.66	10.14	10.73
April	9.60	9.84	10.28	10.71
May	9.87	10.14	10.53	10.92
June	9.67	9.94	10.28	10.65
July	9.73	10.06	10.46	10.71
August	9.74	10.23	10.58	10.90
September	9.46	9.96	10.32	10.65
October	9.42	9.86	10.23	10.58
November	9.64	10.03	10.44	10.79
December	9.60	9.99	10.45	10.81
Monthly averages	9.55%	9.92%	10.36%	10.76%

Source: Standard and Poor's Corporation, *Bond Guide*, January 1989.

They are generally issued during the reorganization of a firm facing financial difficulties. The maturity of income bonds is usually much longer than that of other bonds in order to relieve pressure associated with the repayment of principal. While interest payments may be passed, unpaid interest is generally allowed to accumulate for some period of time and must be paid prior to the payment of any common stock dividends. This cumulative interest feature provides the bondholder with some security.

Types of Bonds: Secured Long-Term Bonds

Mortgage Bonds

A **mortgage bond** is a bond secured by a lien on real property. Typically, the value of the real property being secured is greater than that of the mortgage bonds issued. This provides the mortgage bondholders with a margin of safety in the event the market value of the secured property declines. In the case of foreclosure, the trustees have the power to sell the secured property and use the proceeds to pay the bondholders. In the event that the proceeds from this sale do not cover the bonds, the bondholders become general creditors, similar to debenture bondholders, for the unpaid portion of the debt. While a mortgage bond is a general classification for bonds secured by real property, they can be further differentiated among themselves to include subclassifications of mortgage bonds, blanket mortgage bonds, and closed-, open-, and limited open-end mortgage bonds.

1. **First mortgage bonds.** The same property may be pledged on more than one mortgage bond. In this case, the first mortgage bond has the senior claim on the secured assets.
2. **Second mortgage bonds.** The second mortgage bond has the second claim on assets and is serviced only after the claims of the first mortgage bonds have been satisfied. Obviously, second mortgage bonds are much less secure than first mortgage bonds, and they are not extremely popular. They are seldom issued except by firms experiencing financial difficulties. When they are issued, buyers generally demand a relatively high return because of their risky position.
3. **Blanket or general mortgage bonds.** Under a blanket or general mortgage bond, all the assets of the firm act as security.
4. **Closed-end mortgage bonds.** A closed-end mortgage bond forbids the use of the assets being secured by this bond as security in the issuance of any future mortgage bonds of the same priority. This type of mortgage assures bondholders that their claim on assets will not be diluted by the issuance of any future mortgage bonds. Although this type of mortgage bond restricts the financial manager's future financing options, it is extremely well liked by bondholders.
5. **Open-end mortgage bonds.** An open-end mortgage bond does not preclude the issuance of additional mortgage bonds of the same priority that use the same secured asset as security. Generally, a restriction is placed upon the borrower, requiring that additional assets be added to the secured property if new debt is issued.
6. **Limited open-end mortgage bonds.** Limited open-end mortgage bonds are a hybrid of the open- and closed-end mortgage bonds. Although they allow the issuance of additional bonds at the same priority level using the already mortgaged assets as security, they also limit the amount of these additional bonds that can be issued.

company and pays interest and principal to the lender in U.S. dollars. The Eurobond market actually had its roots in the 1950s and 1960s as the U.S. dollar became increasingly popular because of its role as the primary international reserve. In recent years as the U.S. dollar has gained a reputation for being one of the most stable currencies, demand for Eurobonds has increased. The primary attraction to borrowers, aside from favorable rates, in the Eurobonds market is the relative lack of regulation (Eurobonds are not registered with the SEC), less rigorous disclosure requirements than those required by the SEC, and the speed with which they can be issued. Interestingly, not only are Eurobonds not registered with the SEC, but U.S. citizens and residents may not be offered them during their initial distribution.

The use of Eurobonds by U.S. firms to raise funds has fluctuated dramatically, with the relative interest rates and abundance or lack of funds in the European markets dictating the degree to which they are used. For example, while only about $400 million was raised with Eurobonds in 1981, over $42 billion was raised in 1985. Without question, cost considerations have pushed U.S. firms into this market. The *Reading in Financial Management*, "Wayne Marr and John Trimble on Eurobond Borrowing," deals with the growth of this market.

Zero and Very Low Coupon Bonds

Zero and **very low coupon bonds** allow the issuing firm to issue bonds at a substantial discount from their $1,000 face value with a zero or very low coupon. The investor receives a large part (or all on the zero coupon bond) of the return from the appreciation of the bond. For example, in April 1983 Homestead Savings issued $60 million of debt maturing in 1995 with a zero coupon rate. These bonds were sold at a 75 percent discount from their par value; that is, investors only paid $250 for a bond with a $1,000 par value. Investors who purchase these bonds for $250 and hold them until they mature in 1995 will receive an 11.50 percent yield to maturity, with all of this yield coming from appreciation of the bond. Homestead Savings, on the other hand, will have no cash outflows until these bonds mature; however, at that time it will have to pay back $60 million even though it only received $15 million when the bonds were first issued.

As with any form of financing, there are both advantages and disadvantages of issuing zero or very low coupon bonds. The disadvantages are, first (as already mentioned), when the bonds mature Homestead Savings will face an extremely large nondeductible cash outflow, much greater than the cash inflow it experienced when the bonds were first issued. Second, discount bonds are not callable and can only be retired at maturity. Thus, if interest rates fall, Homestead Savings cannot benefit. The advantages of zero and low coupon bonds are, first, that annual cash outflows associated with interest payments do not occur with zero coupon bonds and are at a relatively low level with low coupon bonds. Second, since there is relatively strong investor demand for this type of debt, prices tend to be bid up and yields tend to be bid down. That is to say, Homestead Savings was able to issue zero coupon bonds at about half a percent less than it would have been if they had been traditional coupon bonds. Finally, Homestead Savings is able to deduct the annual amortization of the discount, which will provide a positive annual cash flow to Homestead.

During 1981 and 1982 zero coupon bonds accounted for about 25 and 14 percent, respectively, of all industrial bond offerings. However, they fell somewhat out of favor in mid-1982 with the passage of TEFRA, which made investors purchasing them pay taxes on the amortized discount. As a result,

during the year of the refunding. The costs include issuing and recalling expenses and any interest expenses during the bond overlap period. An **overlap period,** when the new bonds have been issued and the old bonds have not yet been called, generally occurs because firms wish to obtain the funds from the new issue before calling the old bonds. This eliminates the risk of a rise in interest rates or a drying up of funds in the capital markets after the old debt has been called but before the new debt has been issued. Thus, the cost associated with the additional interest payment can be viewed as the cost of elimination of this risk.

While the calculations associated with a bond-refunding decision appear to be quite complex, it should be remembered that we are merely determining the net present value of this decision. The major difference between the refunding decision and capital budgeting, as presented in Chapter 5, is that the discount rate used in refunding is the after-tax cost of borrowing on the new bonds rather than the firm's cost of capital. This is because in a refunding decision, as opposed to a normal investment decision, the costs and benefits are known with complete certainty. In effect, a refunding decision is an example of a riskless investment. The only risk involved is the risk of the firm's defaulting on the interest or principal payments. Thus, because the after-tax cost of borrowing on the new bonds takes into account this default risk, it is the appropriate discount rate. The following example will illustrate and explain these calculations.[9]

EXAMPLE

Suppose that interest rates have just fallen and that a firm in the 34 percent tax bracket has a $50 million, 9 percent debenture issue outstanding with 20 years remaining to maturity. The unamortized flotation costs and discount on the old bonds total $3 million. These bonds contain a call provision and can be called at $104 (that is, $104 for each $100 of par). Let us assume that they could be replaced with a $50 million issue of 8 percent 20-year bonds providing the firm with $48 million after flotation costs. That is to say, the discount on the new bonds is $2 million ($50 million − $48 million). Let us further assume that an additional $400,000 in issuing expenses would be incurred. The overlap period during which both issues will be outstanding is expected to be one month. Finally, since the marginal corporate tax rate is 34 percent, the appropriate discount rate is 8% (1 − .34) = 5.28 percent.

The procedure for arriving at a decision involves first determining the initial outlay and the differential cash flows. Then all the flows are discounted back to the present and the net present value of the refunding decision is determined. These calculations are illustrated in Table 19–5. In this example the net present value of the refunding decision is $944,971. Since this is positive, the refunding proposal should be accepted.

[9]The subject of the appropriate discount rate to be used in discounting the benefits of a bond refund back to present has received considerable attention. See, for example, Thomas H. Mayor and Kenneth G. McCoin, "The Rate of Discounting in Bond Refunding," *Financial Management*, 3 (Autumn 1974), 54–58; and Aharon R. Ofer and Robert A. Taggart, Jr., "Bond Refunding: A Clarifying Analysis," *Journal of Finance*, 32 (March 1977), 21–30. Ofer and Taggart show that the relevant discount rate is the after-tax cost of the refunding bonds when new bonds are used to replace the existing bonds.

CHAPTER 20

Convertibles, Warrants, Options, and Futures

Convertible Securities • Warrants • Futures • Options • The Use of Options and Futures by Financial Managers

In earlier chapters we concerned ourselves with methods of raising long-term funds through the use of common stock, preferred stock, and short- and long-term debt. In this chapter we will examine how convertibles and warrants can be used to increase the attractiveness of these securities. We have grouped convertibles and warrants together in our discussion because both can be exchanged at the owner's discretion for a specified number of shares of common stock. In investigating each financing alternative we will look first at its specific characteristics and purpose; then we will focus on any special considerations that should be examined before it is issued. Our attention will then turn to two additional financial instruments that are similar to warrants and convertibles but are not created by the firm: options and futures. Much of our interest in options and futures stems from our ability to use these instruments to eliminate risks associated with interest and exchange rate and commodity price fluctuations.

Convertible Securities

A **convertible security** is a preferred stock or a debt issue that can be exchanged for a specified number of shares of common stock at the will of the owner. It provides the stable income associated with preferred stock and bonds in addition to the possibility of capital gains associated with common stock. This combining of features has led convertibles to be called *hybrid* securities.

When the convertible is initially issued, the firm receives the proceeds from the sale, less flotation costs. This is the only time the firm receives any proceeds from issuing convertibles. The firm then treats this convertible as if it were normal preferred stock or debentures, paying dividends or interest

regularly. If the security owner wishes to exchange the convertible for common stock, he or she may do so at any time according to the terms specified when the convertible was originally issued. The desire to convert generally follows a rise in the price of the common stock. Once the convertible owner trades the convertibles in for common stock, the owner can never trade the stock back for convertibles. From then on the owner is treated as any other common stockholder and receives only common stock dividends.

Characteristics and Features of Convertibles

Conversion Ratio

The number of shares of common stock for which the convertible security can be exchanged is set out when the convertible is initially issued. On some convertible issues this **conversion ratio** is stated directly. For example, the convertible may state that it is exchangeable for 15 shares of common stock. Some convertibles give only a **conversion price**, stating, for example, that the security is convertible at $39 per share. This tells us that for every $39 of par value of the convertible security one share of common stock will be received.

$$\text{conversion ratio} = \frac{\text{par value of convertible security}}{\text{conversion price}} \qquad \textbf{(20-1)}$$

For example, in 1987 Union Carbide issued $350 million of convertible debentures that mature in 2012. These convertibles have a $1,000 par value, a 7½ percent coupon interest rate, and a conversion price of $35.50. Thus, the conversion ratio—the number of shares to be received upon conversion—is $1000/$35.50 = 28.169 shares. In effect, the security owner has the choice of holding the 7½ percent convertible debenture or trading it in for 28.169 shares of Union Carbide common stock. In this case the bond indenture states how the fractional shares are to be dealt with, either by issuing fractional shares, allowing the security holder to purchase the unissued fractional share, or paying the investor for the fractional share.

Conversion Value

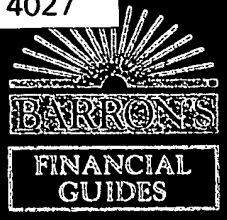
The **conversion value** of a convertible security is the total market value of the common stock for which it can be exchanged. This can be calculated as follows:

$$\begin{pmatrix}\text{conversion}\\ \text{value}\end{pmatrix} = \begin{pmatrix}\text{conversion}\\ \text{ratio}\end{pmatrix} \times \begin{pmatrix}\text{market value per share}\\ \text{of the common stock}\end{pmatrix} \qquad \textbf{(20-2)}$$

If the Union Carbide common stock were selling for, say, $24 per share, as it was in early 1990, then the conversion value for the Union Carbide convertible would be (28.169)($24.00) = $676.06, that is, the market value of the common stock for which the convertible could be exchanged would be $676.06. Thus, regardless of what this convertible debenture was selling for, it could be converted into $676.06 worth of common stock.

Security Value

The **security value** (or bond value, as it is sometimes called) of a convertible security is the price the convertible security would sell for in the absence of its conversion feature. This is calculated by determining the required rate of return on a straight (nonconvertible) issue of the same quality and then determining the present value of the interest and principal payments at this rate of return. For example, the Union Carbide convertible has a Standard and Poor's BB–



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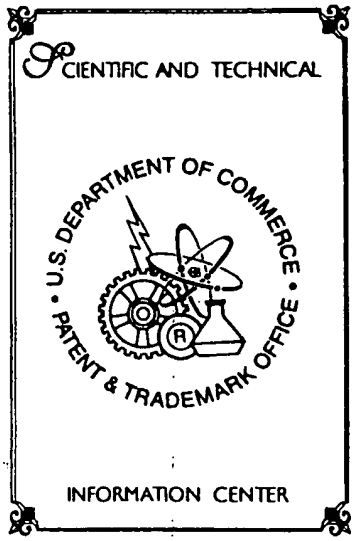

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option is very small, on the other hand, since the option may never be profitable.

DEFAULT failure of a debtor to make timely payments of interest and principal as they come due or to meet some other provision of a bond indenture. In the event of default, bondholders may make claims against the assets of the issuer in order to recoup their principal.

DEFAULT RISK risk that a debtholder will not receive interest and principal when due. One way to gauge default risk is the RATINGS issued by credit rating agencies such as Fitch Investors Service, Moody's, and Standard & Poor's. The higher the rating (AAA or Aaa is highest), the less risk of default. Some issues, such as Treasury bonds backed by the full faith and credit of the U.S. government, are considered free of default risk. Other bonds, such as JUNK BONDS, carry a much higher default risk. One investor defense against default for municipal bonds is MUNICIPAL BOND INSURANCE.

DEFEASANCE

In general: provision found in some debt agreements whereby the contract is nullified if specified acts are performed.

Corporate finance: short for in-substance defeasance, a technique whereby a corporation discharges old, low-rate debt without repaying it prior to maturity. The corporation uses newly purchased securities with a lower face value but paying higher interest or having a higher market value. The objective is a cleaner (more debt free) balance sheet and increased earnings in the amount by which the face amount of the old debt exceeds the cost of the new securities. The use of defeasance in modern corporate finance began in 1982 when Exxon bought and put in an irrevocable trust $312 million of U.S. government securities yielding 14% to provide for the repayment of principal and interest on $515 million of old debt paying 5.8% to 6.7% and maturing in 2009. Exxon removed the defeased debt from its balance sheet and added $132 million—the after-tax difference between $515 million and $312 million—to its earnings that quarter.

In another type of defeasance, a company instructs a broker to buy, for a fee, the outstanding portion of an old bond issue of the company. The broker then exchanges the bond issue for a new issue of the company's stock with an equal market value. The broker subsequently sells the stock at a profit.

DEFENSIVE SECURITIES stocks and bonds that are more stable than average and provide a safe return on an investor's money. When the stock market is weak, defensive securities tend to decline less than the overall market.

DEFERRAL OF TAXES postponement of tax payments from this year to a later year. For instance, an INDIVIDUAL RETIREMENT ACCOUNT (IRA) defers taxes until the money is withdrawn.

DEFERRED ACCOUNT account that postpones taxes until a later date. Some examples: ANNUITY, INDIVIDUAL RETIREMENT ACCOUNT, KEOGH PLAN accounts, PROFIT-SHARING PLAN, SALARY REDUCTION PLAN, SIMPLIFIED EMPLOYEE PENSION (SEP) PLAN.

DEFERRED ANNUITY *see* DEFERRED PAYMENT ANNUITY.

DEFERRED CHARGE expenditure carried forward as an asset until it becomes relevant, such as an advance rent payment or insurance premium. The opposite is *deferred income,* such as advance rent received.

DEFERRED COMPENSATION currently earned compensation that, under the terms of a profit-sharing, pension, or stock option plan, is not actually paid until a later date and is therefore not taxable until that date.

DEFERRED INTEREST BOND bond that pays interest at a later date. A ZERO COUPON BOND, which pays interest and repays principal in one lump sum at maturity, is in this category. In effect, such bonds automatically reinvest the interest at a fixed rate. Prices are more volatile for a deferred interest bond than for a CURRENT COUPON BOND.

DEFERRED PAYMENT ANNUITY ANNUITY whose contract provides that payments to the annuitant be postponed until a number of periods have elapsed—for example, when the annuitant attains a certain age. Also called a *deferred annuity.*

DEFERRED SALES CHARGE *see* BACK-END LOAD.

DEFICIENCY LETTER written notice from the Securities and Exchange Commission to a prospective issuer of securities that the preliminary prospectus needs revision or expansion. Deficiency letters require prompt action; otherwise, the registration period may be prolonged.

DEFICIT

1. excess of liabilities and debts over income and assets. Deficits usually are corrected by borrowing or by selling assets.
2. in finance, an excess of expenditures over budget.

DEFICIT FINANCING borrowing by a government agency to make up for a revenue shortfall. Deficit financing stimulates the economy for a time but eventually can become a drag on the economy by pushing up interest rates. *See also* CROWDING OUT; KEYNESIAN ECONOMICS.

DEFICIT NET WORTH excess of liabilities over assets and capital stock, perhaps as a result of operating losses. Also called *negative net worth.*

DEFICIT SPENDING excess of government expenditures over government revenue, creating a shortfall that must be financed through borrowing. *See also* DEFICIT FINANCING.

DEFINED ASSET FUND a UNIT INVESTMENT TRUST with a fixed portfolio of securities offered by Merrill Lynch, Salomon Smith Barney,

PREPAYMENT PENALTY fee paid by a borrower to a bank when a loan or mortgage that does not have a prepayment clause is repaid before its scheduled maturity. Prepayment penalties are prohibited in many states, and by FANNIE MAE and FREDDIE MAC. Also called *prepayment fee.*

PREREFUNDING procedure, called a *pre-re* on Wall Street, in which a bond issuer floats a second bond in order to pay off the first bond at the first CALL date. The proceeds from the sale of the second bond are safely invested, usually in Treasury securities, that will mature at the first call date of the first bond issue. Those first bonds are said to be prerefunded after this operation has taken place. Bond issuers prerefund bonds during periods of lower interest rates in order to lower their interest costs. *See also* ADVANCE REFUNDING; REFUNDING; REFUNDING ESCROW DEPOSITS (REDS).

PRESALE ORDER order to purchase part of a new MUNICIPAL BOND issue that is accepted by an underwriting SYNDICATE MANAGER before an announcement of the price or COUPON rate and before the official PUBLIC OFFERING. Municipals are exempt from registration requirements and other rules of the Securities and Exchange Commission, which forbids preoffering sales of corporate bond issues. *See also* PRESOLD ISSUE.

PRESENT VALUE value today of a future payment, or stream of payments, discounted at some appropriate compound interest—or discount—rate. For example, the present value of $100 to be received 10 years from now is about $38.55, using a discount rate equal to 10% interest compounded annually.

The present value method, also called the DISCOUNTED CASH FLOW method, is widely used in corporate finance to measure the return on a CAPITAL INVESTMENT project. In security investments, the method is used to determine how much money should be invested today to result in a certain sum at a future time. Present value calculations are facilitated by present value tables, which are compound interest tables in reverse. Also called *time value of money.*

PRESIDENT highest-ranking officer in a corporation after the CHAIRMAN OF THE BOARD, unless the title CHIEF EXECUTIVE OFFICER (CEO) is used, in which case the president can outrank the chairman. The president is appointed by the BOARD OF DIRECTORS and usually reports directly to the board. In smaller companies the president is usually the CEO, having authority over all other officers in matters of day-to-day management and policy decision-making. In large corporations the CEO title is frequently held by the chairman of the board, leaving the president as CHIEF OPERATING OFFICER, responsible for personnel and administration on a daily basis.

PRESIDENTIAL ELECTION CYCLE THEORY hypothesis of investment advisers that major stock market moves can be predicted based on the four-year presidential election cycle. According to this theory, stocks decline soon after a president is elected, as the chief executive takes the harsh and unpopular steps necessary to bring inflation, government spending, and deficits under control. During the next two years or so, taxes may be raised and the economy may slip into a recession. About midway into the four-year cycle, stocks should start to rise in anticipation of the economic recovery that the incumbent president wants to be roaring at full steam by election day. The cycle then repeats itself with the election of a new president or the reelection of an incumbent.

PRESOLD ISSUE issue of MUNICIPAL BONDS or government bonds that is completely sold out before the price or yield is publicly announced. Corporate bond issues, which must be offered to the public with a Securities and Exchange Commission registration statement, cannot legally be presold. *See also* PRESALE ORDER.

PRETAX EARNINGS OR PROFITS NET INCOME (earnings or profits) before federal income taxes.

PRETAX RATE OF RETURN yield or capital gain on a particular security before taking into account an individual's tax situation. *See also* RATE OF RETURN.

PREVIOUS BALANCE METHOD method of charging credit card interest that uses the outstanding balance at the end of the previous month as the basis for the current month's interest computation. *See also* ADJUSTED BALANCE METHOD.

PRICE/BOOK RATIO ratio of a stock's price to its BOOK VALUE per share. This number is used by SECURITIES ANALYSTS and MONEY MANAGERS to judge whether a stock is undervalued or overvalued. A stock selling at a high price/book ratio, such as 3 or higher, may represent a popular GROWTH STOCK with minimal book value. A stock selling below its book value may attract value-oriented investors who think that the company's management may undertake steps, such as selling assets or restructuring the company, to unlock the hidden value on the company's BALANCE SHEET.

PRICE CHANGE net rise or fall of the price of a security at the close of a trading session, compared to the previous session's CLOSING PRICE. A stock that rose $2 in a day would have a + 2 after its final price in the newspaper stock listings. A stock that fell $2 would have a –2. The average of the price changes for groups of securities, in indicators such as the Dow Jones Industrial Average and Standard & Poor's 500 Stock Index, is calculated by taking into account all the price changes in the components of the average or index.

PRICE/EARNINGS RATIO (P/E) price of a stock divided by its earnings per share. The P/E ratio may either use the reported earnings from the latest year (called a *trailing P/E*) or employ an analyst's forecast

RISK PREMIUM in PORTFOLIO THEORY, the difference between the RISK-FREE RETURN and the TOTAL RETURN from a risky investment. In the CAPITAL ASSET PRICING MODEL (CAPM), the risk premium reflects market-related risk (SYSTEMATIC RISK) as measured by BETA. Other models also reflect specific risk as measured by ALPHA.

RISK-RETURN TRADE-OFF concept, basic in investment management, that RISK equals (varies with) RETURN; in other words, the higher the return the greater the risk and vice versa. In practice, it means that a speculative investment, such as stock in a newly formed company, can be expected to provide a higher potential return than a more conservative investment, such as BLUE CHIP or a BOND. Conversely, if you don't want the risk, don't expect the return. *See also* PORTFOLIO THEORY.

RISK TRANSFER shifting of risk, as with INSURANCE or the SECURITIZATION of debt.

ROAD SHOW presentation by an issuer of securities to potential buyers about the merits of the issue. Management of the company issuing stocks or bonds doing a road show travels around the country presenting financial information and an outlook for the company and answering the questions of analysts, fund managers, and other potential investors. Also known as a *dog and pony show.*

ROCKET SCIENTIST investment firm creator of innovative securities.

ROLL DOWN move from one OPTION position to another one having a lower EXERCISE PRICE. The term assumes that the position with the higher exercise price is closed out.

ROLL FORWARD move from one OPTION position to another with a later expiration date. The term assumes that the earlier position is closed out before the later one is established. If the new position involves a higher EXERCISE PRICE, it is called a *roll-up and forward;* if a lower exercise price, it is called a *roll-down and forward.* Also called *rolling over.*

ROLLING STOCK equipment that moves on wheels, used in the transportation industry. Examples include railroad cars and locomotives, tractor-trailers, and trucks.

ROLLOVER

1. movement of funds from one investment to another. For instance, an INDIVIDUAL RETIREMENT ACCOUNT may be rolled over when a person retires into an ANNUITY or other form of pension plan payout system. Balances in regular IRAs can be rolled over into ROTH IRAS, although income taxes will be due on untaxed earnings in the regular IRA account. When a BOND or CERTIFICATE OF DEPOSIT matures, the funds may be rolled over into another bond or certificate of deposit. A stock may be sold and the proceeds rolled over into the same stock, establishing a different cost basis for the shareholder. *See also* THIRTY DAY WASH RULE.

2. term often used by banks when they allow a borrower to delay making a PRINCIPAL payment on a loan. Also, a country that has difficulty in meeting its debt payments may be granted a rollover by its creditors. With governments themselves, rollovers in the form of REFUNDINGS or REFINANCINGS are routine.

See also CERTIFICATE OF DEPOSIT ROLLOVER.

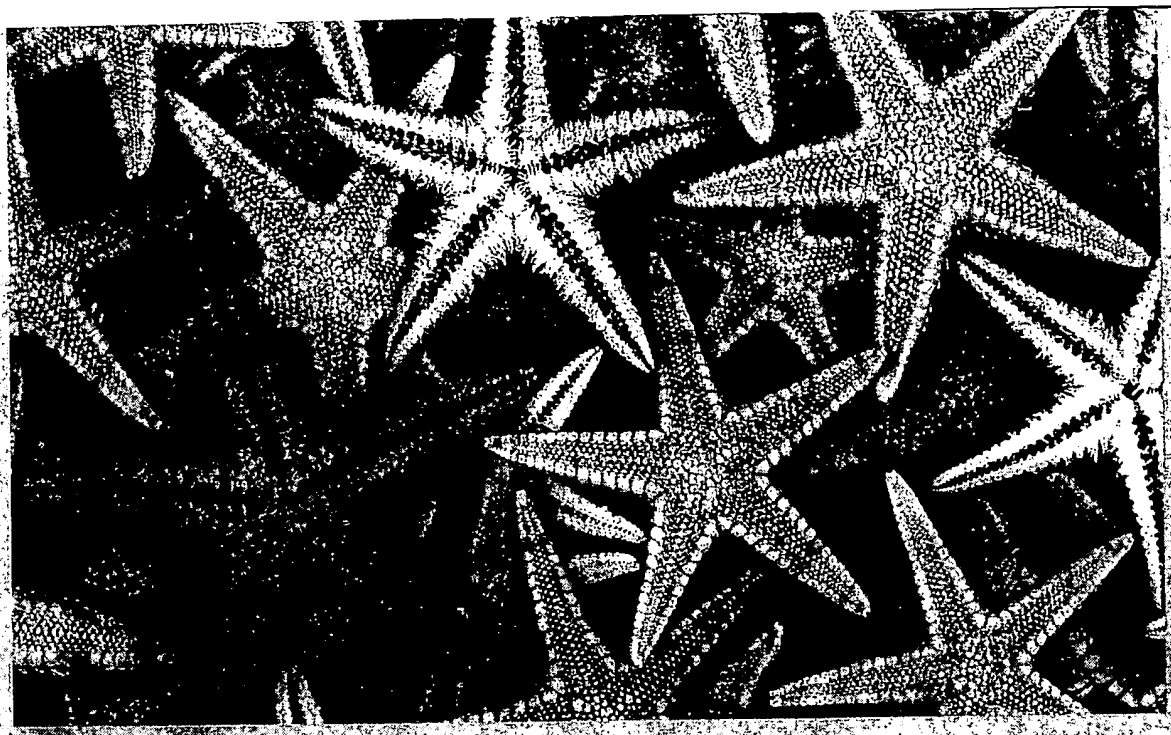
ROLL UP move from one OPTION position to another having a higher EXERCISE PRICE. The term assumes that the earlier position is closed out before the new position is established. *See also* MASTER LIMITED PARTNERSHIP.

ROTH IRA INDIVIDUAL RETIREMENT ACCOUNT created by the TAXPAYER RELIEF ACT OF 1997 permitting account holders to allow their capital to accumulate tax free under certain conditions. The Roth IRA is named after Delaware Senator William V. Roth Jr., who championed the idea of expanded IRAs. Individuals can invest up to $2,000 per year, and they can withdraw the principal and earnings totally tax free after age 59½, as long as the assets have remained in the IRA for at least 5 years after making the first contribution. If the account holder dies before they start withdrawing from a Roth, the proceeds go to their beneficiaries tax free. Unlike regular IRAs, participants do not have to take any distributions from a Roth IRA starting at age 70½, nor do they have to take any distributions at all during their lifetime. They can also continue to contribute after reaching age 70½.

Participants in Roth IRAs do not receive deductions for contributing to the account. However, the value of completely tax free withdrawals usually outweighs the tax break from upfront deductions. The Roth IRA also permits participants to withdraw assets without the usual 10% early withdrawal penalty if the proceeds are used to purchase a first home (withdrawals are limited to $10,000), for college expenses, or if the participant becomes disabled.

There are income limitations governing who can open Roth IRAs. Married couples with an adjusted gross income of $150,000 or less or singles with adjusted gross incomes of $95,000 or less can contribute the full $2,000. Contribution amounts are phased out for incomes between $150,000 and $160,000 for couples filing jointly and between $95,000 and $110,000 for singles. Those with income over these limits can not contribute to a Roth IRA.

Individuals with adjusted gross income of $100,000 or less can roll over existing and deductible IRA balances into a Roth without the usual 10% early distribution penalty, although regular income taxes are due on untaxed earnings in the account. For such ROLLOVERS completed before January 1, 1999, the resulting tax bill is spread over four years. After that, the rollover is fully taxable in the year it is completed. Figuring out whether or not it is advantageous to roll over assets from a regular IRA to a Roth IRA is a complex decision, and may require advice from a financial professional. *See* ROLLOVER.



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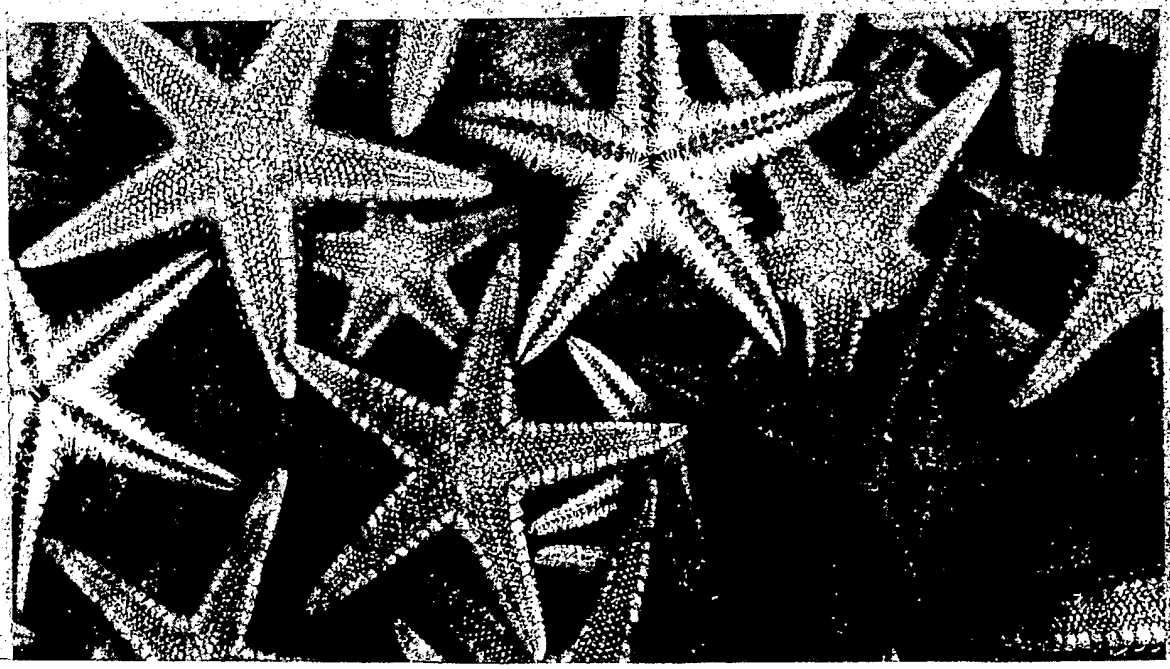

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Arizona State University

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Contents

4.81 Refer to Exercise 4.75. A U.S. farm is selected at random.

a. Use the letters in the margins of the contingency table to represent each of the following three events: The farm obtained (i) has between 180 and 500 acres, (ii) is part-owner operated, and (iii) is full-owner operated and has at least 1000 acres.
b. Compute the probability of each event in part (a).
c. Construct a **joint percentage distribution,** a table similar to a joint probability distribution except with percentages replacing probabilities.

4.82 Refer to Exercise 4.76. A U.S. family is selected at random.

a. Use the letters in the margins of the contingency table to represent each of the following three events: The family obtained (i) has only the wife present, (ii) makes at least $75,000, and (iii) has only the husband present and makes between $15,000 and $35,000.
b. Determine the probability of each event in part (a).
c. Construct a **joint percentage distribution,** a table similar to a joint probability distribution except with percentages replacing probabilities.

Extending the Concepts and Skills

4.83 Explain why the joint events in a contingency table are mutually exclusive.

4.84 In this exercise you are asked to verify that the sum of the joint probabilities in a row or column of a joint probability distribution equals the marginal probability in that row or column. Consider the following joint probability distribution.

	C_1	$\cdots$	C_n	$P(R_i)$
R_1	$P(R_1 \& C_1)$	$\cdots$	$P(R_1 \& C_n)$	$P(R_1)$
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
R_m	$P(R_m \& C_1)$	$\cdots$	$P(R_m \& C_n)$	$P(R_m)$
$P(C_j)$	$P(C_1)$	$\cdots$	$P(C_n)$	1

a. Explain why we can write

$$R_1 = \big((R_1 \& C_1) \text{ or } \cdots \text{ or } (R_1 \& C_n)\big).$$

b. Why are the events $(R_1 \& C_1), \ldots, (R_1 \& C_n)$ mutually exclusive?
c. Explain why parts (a) and (b) imply that

$$P(R_1) = P(R_1 \& C_1) + \cdots + P(R_1 \& C_n).$$

This equation shows that the first row of joint probabilities sums to the marginal probability at the end of that row. A similar argument applies to any other row or column.

4.5 CONDITIONAL PROBABILITY*

In this section we introduce the concept of conditional probability. The **conditional probability** of an event is the probability that the event occurs under the assumption that another event has occurred.

DEFINITION 4.6 CONDITIONAL PROBABILITY

The probability that event B occurs given that event A has occurred is called a ***conditional probability.*** It is denoted by the symbol $P(B \mid A)$, which is read "the probability of B given A." We call A the ***given event.***

EXAMPLE 4.16 ILLUSTRATES DEFINITION 4.6

When a balanced die is rolled once, six equally likely outcomes are possible, as displayed in Fig. 4.22.

FIGURE 4.22 Sample space for rolling a die once

Let

F = event a 5 is rolled,

O = event the die comes up odd.

Determine the following probabilities:

a. $P(F)$, the probability that a 5 is rolled.

b. $P(F \mid O)$, the conditional probability that a 5 is rolled given that the die comes up odd.

c. $P\big(O \mid (\text{not } F)\big)$, the conditional probability that the die comes up odd given that a 5 is not rolled.

SOLUTION **a.** To obtain $P(F)$, the probability that a 5 is rolled, we proceed as usual. From Fig. 4.22 we see that six outcomes are possible. Also, event F can occur in only one way: if the die comes up 5. Thus the probability that a 5 is rolled equals

$$P(F) = \frac{f}{N} = \frac{1}{6} = 0.167.$$

b. Given that the die comes up odd, that is, that event O has occurred, there are no longer six possible outcomes. There are only three, as shown in Fig. 4.23.

FIGURE 4.23 Event O

Therefore the conditional probability that a 5 is rolled given that the die comes up odd equals

$$P(F \mid O) = \frac{f}{N} = \frac{1}{3} = 0.333.$$

Comparing this probability with the one that we obtained in part (a), we see that $P(F \mid O) \neq P(F)$; that is, the conditional probability that a 5 is rolled given

that the die comes up odd is not the same as the (unconditional) probability that a 5 is rolled. Knowing that the die comes up odd affects the probability that a 5 is rolled.

c. Given that a 5 is not rolled, that is, that event (not F) has occurred, the possible outcomes are the five shown in Fig. 4.24.

FIGURE 4.24
Event (not F)

Under these circumstances, event O (odd) can occur in two ways: if a 1 or a 3 is rolled. So the conditional probability that the die comes up odd given that a 5 is not rolled equals

$$P(O \mid (\text{not } F)) = \frac{f}{N} = \frac{2}{5} = 0.4.$$

Compare this probability with the (unconditional) probability that the die comes up odd, which is 0.5. ■

Conditional probability is often used to analyze bivariate data. In Section 4.4 we discussed contingency tables as a method for tabulating such data. Now we will learn how to obtain conditional probabilities for bivariate data directly from a contingency table.

EXAMPLE 4.17 ILLUSTRATES DEFINITION 4.6

Table 4.8, shown at the top of the next page, repeats the contingency table for age and rank of ASU faculty members. Suppose an ASU faculty member is selected at random.

a. Determine the (unconditional) probability that the faculty member selected is in his or her 50s.

b. Determine the (conditional) probability that the faculty member selected is in his or her 50s given that an assistant professor is selected.

c. Interpret the probabilities obtained in parts (a) and (b) in terms of percentages.

SOLUTION **a.** Here we are to determine the probability that the faculty member selected is in his or her 50s (event A_4). From Table 4.8 we see that $N = 1164$, since the total number of faculty members is 1164. Also, because 253 of the faculty members

TABLE 4.8
Contingency table for age and rank of ASU faculty members

Age \ Rank	Full professor R_1	Associate professor R_2	Assistant professor R_3	Instructor R_4	Total
Under 30 A_1	2	3	57	6	68
30–39 A_2	52	170	163	17	402
40–49 A_3	156	125	61	6	348
50–59 A_4	145	68	36	4	253
60 & over A_5	75	15	3	0	93
Total	430	381	320	33	1164

are in their 50s, we have $f = 253$. So

$$P(A_4) = \frac{f}{N} = \frac{253}{1164} = 0.217.$$

b. For this part we are to find the probability that the faculty member selected is in his or her 50s (event A_4) given that an assistant professor is selected (event R_3). To obtain that probability, we restrict our attention to the assistant-professor column of Table 4.8. We have $N = 320$, since the total number of assistant professors is 320. Also, because 36 of the assistant professors are in their 50s, we have $f = 36$. Consequently,

$$P(A_4 \mid R_3) = \frac{f}{N} = \frac{36}{320} = 0.113.$$

c. In terms of percentages, $P(A_4) = 0.217$ means that 21.7% of the faculty are in their 50s; $P(A_4 \mid R_3) = 0.113$ means that 11.3% of the assistant professors are in their 50s. ◨

The Conditional-Probability Rule

In the previous two examples, we computed conditional probabilities *directly*, meaning that we first obtained the new sample space determined by the given event and then, using the new sample space, we calculated probabilities in the usual man-

ner. For instance, in Example 4.16(b), we computed the conditional probability that a 5 is rolled given that the die comes up odd. To do that we first obtained the new sample space (in this case, 1, 3, 5) and then went on from there.

Sometimes we cannot determine conditional probabilities directly but must instead compute them in terms of unconditional probabilities. To see how this can be done, we return to the situation of Example 4.17.

EXAMPLE 4.18 INTRODUCES THE CONDITIONAL-PROBABILITY RULE

In Example 4.17(b) we determined the conditional probability that a faculty member is in his or her 50s (event A_4) given that an assistant professor is selected (event R_3). To accomplish that we restricted our attention to the R_3 column of Table 4.8 and obtained

$$P(A_4 \mid R_3) = \frac{36}{320} = 0.113.$$

This is a direct computation of the conditional probability $P(A_4 \mid R_3)$. Compute the conditional probability $P(A_4 \mid R_3)$ using unconditional probabilities.

SOLUTION First we note that the number 36 in the numerator of the above fraction is the number of assistant professors in their 50s, that is, the number of ways event $(R_3 \ \& \ A_4)$ can occur. Next we observe that the number 320 in the denominator of the above fraction is the total number of assistant professors, that is, the number of ways event R_3 can occur. So the numbers 36 and 320 are those used to compute the unconditional probabilities of events $(R_3 \ \& \ A_4)$ and R_3, respectively:

$$P(R_3 \ \& \ A_4) = \frac{36}{1164} = 0.031, \qquad P(R_3) = \frac{320}{1164} = 0.275.$$

From the previous three probabilities, we see that

$$P(A_4 \mid R_3) = \frac{36}{320} = \frac{\frac{36}{1164}}{\frac{320}{1164}} = \frac{P(R_3 \ \& \ A_4)}{P(R_3)}.$$

Consequently, the conditional probability $P(A_4 \mid R_3)$ can be obtained from the unconditional probabilities $P(R_3 \ \& \ A_4)$ and $P(R_3)$ by using the formula

$$P(A_4 \mid R_3) = \frac{P(R_3 \ \& \ A_4)}{P(R_3)}.$$

That formula holds in general and is called the **conditional-probability rule.** ■

FORMULA 4.4 THE CONDITIONAL-PROBABILITY RULE

If A and B are any two events, then

$$P(B \mid A) = \frac{P(A \,\&\, B)}{P(A)}.$$

In words, for any two events, the conditional probability that one event occurs given that the other event has occurred equals the joint probability of the two events divided by the probability of the given event.†

For the faculty-member example, conditional probabilities can be obtained either directly or by applying the conditional-probability rule. However, as Example 4.19 illustrates, the conditional-probability rule is sometimes the only way conditional probabilities can be determined.

EXAMPLE 4.19 ILLUSTRATES FORMULA 4.4

Data on the marital status of U.S. adults can be found in *Current Population Reports*, a publication of the U.S. Bureau of the Census. Table 4.9 provides a joint probability distribution for the marital status of U.S. adults by sex. We have used "Single" as an abbreviation for "Never married."

TABLE 4.9 Joint probability distribution of marital status and sex

		Marital status				
		Single M_1	Married M_2	Widowed M_3	Divorced M_4	$P(S_i)$
Sex	Male S_1	0.129	0.298	0.013	0.040	0.480
	Female S_2	0.104	0.305	0.057	0.054	0.520
	$P(M_j)$	0.233	0.603	0.070	0.095	1.000

A U.S. adult is selected at random.

a. Determine the probability that the adult selected is divorced, given that the adult selected is a male.

b. Determine the probability that the adult selected is a male, given that the adult selected is divorced.

† To be perfectly correct, we must assume that the given event is not impossible because it is not permissible to divide by 0. In this section, we will assume that both events under consideration are not impossible.

SOLUTION Unlike our previous illustrations with contingency tables, we do not have the frequency data here, only the probability (relative-frequency) data. Because of that we cannot compute conditional probabilities directly; we must use the conditional-probability rule.

a. Here we want $P(M_4 \mid S_1)$. Using the conditional-probability rule and Table 4.9, we get

$$P(M_4 \mid S_1) = \frac{P(S_1 \ \& \ M_4)}{P(S_1)} = \frac{0.040}{0.480} = 0.083.$$

In terms of percentages, this means that 8.3% of adult males are divorced.

b. For this part we want $P(S_1 \mid M_4)$. Using the conditional-probability rule and Table 4.9, we get

$$P(S_1 \mid M_4) = \frac{P(M_4 \ \& \ S_1)}{P(M_4)} = \frac{0.040}{0.095} = 0.421.$$

In other words, 42.1% of divorced adults are males. ◨

EXERCISES 4.5

STATISTICAL CONCEPTS AND SKILLS

4.85 Regarding conditional probability:
a. What is it?
b. Which event is the "given event"?

4.86 Give an example where the conditional probability of an event is the same as the unconditional probability of the event. *(Hint:* Consider the experiment of tossing a coin twice.*)*

For Exercises 4.87–4.92, compute conditional probabilities directly; that is, do not use the conditional-probability rule.

4.87 Suppose one card is selected at random from an ordinary deck of 52 playing cards. Let

A = event a face card is selected,
B = event a king is selected,
C = event a heart is selected.

Determine the following probabilities and express your results in words.
a. $P(B)$ b. $P(B \mid A)$ c. $P(B \mid C)$
d. $P\big(B \mid (\text{not } A)\big)$ e. $P(A)$ f. $P(A \mid B)$
g. $P(A \mid C)$ h. $P\big(A \mid (\text{not } B)\big)$

4.88 A balanced dime is tossed twice. The four possible equally likely outcomes are HH, HT, TH, TT. Let

A = event the first toss is heads,
B = event the second toss is heads,
C = event at least one toss is heads.

Determine the following probabilities and express your results in words.
a. $P(B)$ b. $P(B \mid A)$ c. $P(B \mid C)$
d. $P(C)$ e. $P(C \mid A)$ f. $P\big(C \mid (\text{not } B)\big)$

4.89 The U.S. Bureau of the Census publishes data on housing units in *American Housing Survey in the United States*. The following table provides a frequency distribution for the number of rooms in U.S. housing units. The frequencies are in thousands.

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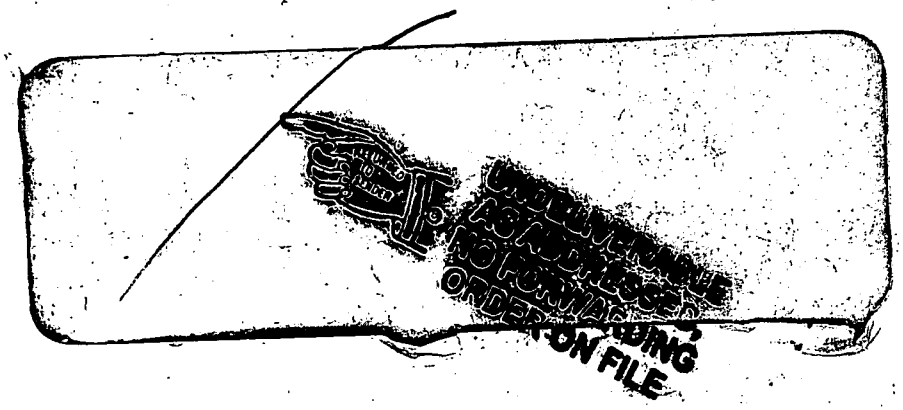

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